

PUBLIC ADMINISTRATION MEETS INFORMATION SYSTEM RESEARCH: ANALYSING FAILURE OF INTERGOVERNMENTAL INFORMATION SYSTEMS VIA IS SUCCESS MODELS

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Complete Research

Abstract. When comparing success rates of information systems in the public and private sector, governments generally lag behind. Information system failure received limited coverage in public administration: not much research has examined whether private sector IS success models can be applied in a public sector context. This paper aims to contribute to this research gap.

We investigate if two IS success models can be applied to study the causes of failure of an e-government system. The first model is 'the Unified Theory of Acceptance and Use of Technology'; the second 'the Updated Information System Success Model'. Our results, based on an exploratory case study analysis, demonstrate that both models have value to analyse intergovernmental information system failure. The combination of IS lenses in a more comprehensive model might be a valuable future contribution to e-government studies.

Keywords: e-government, failure, IS success models, intergovernmental IS

Track: E-government architecture and project success and failure cases

1 Introduction

During the last 15 years public organizations have shifted from a model emphasizing information protection to one of information sharing [31]. Intergovernmental information sharing has become a powerful strategy to improve governmental services and operations. As a result, the implementation of intergovernmental information systems (IS) has been attracting increasing amounts of resources and of research interest and is believed to represent one of the most significant IT implementation and organizational challenges for the next decade [18], [24]. Intergovernmental collaboration in IS knows however a long history of conflict, friction and failure [24] and specific guidance for implementing intergovernmental IS successfully is lacking [1].

Realizing the benefits of IS requires governments to understand and overcome causes of failure. In the context of this paper, we consider success and failure as the level to which system acceptance, usage and experienced benefits meet the expectations (or not) that motivated the development or acquisition of the software. In the past there has been already quite some research on IS failure focusing on aspects such

as utility, ease of use, acceptance and IS success in general. In this stream of literature, success and failure are the flip side of each other and it is assumed that by paying attention to success factors, failure will be avoided. In this line of reasoning, it is worthwhile to explore the causes of failure, since this information may be useful in averting future failures [5].

On the other hand, much of the existing literature focuses primarily on the private sector [26], [8]; little research identifies measures that determine intergovernmental IS failure. To investigate intergovernmental IS failure, two possible approaches can be considered. On the one hand, a bottom up, inductive approach, similar to e.g. in [15], can be followed to identify root causes of intergovernmental IS failure in different cases. These can be generalized to a specific theory for intergovernmental IS failure. On the other hand, we can follow a top-down, deductive approach to examine whether IS success models mainly resulting from research in business information systems can be extended to examine intergovernmental IS failure [25], [1]. Several authors have already advocated that using private sector models in a public sector context might provide new insights on management of intergovernmental IS. First, when comparing the success rates of IS in the public and private sector, governments generally lag behind [10], which indicates that there is room for public sector to learn from the private sector. Second, despite differences between both sectors in terms of access, structure, accountability and mandatory relationships, there are enough similarities to successfully apply private sector models to investigate factors affecting the implementation of IS in the public sector [12]. Finally, public management and IS studies can be coupled, this coupling might strengthen both domains [5] [15]. In this paper, we investigate whether research on IS success factors can be leveraged for the domain of intergovernmental IS. Hence, the main research question is: *Can traditional IS success models be applied to study the causes of failure of intergovernmental information systems?*

For reasons of space limitations, this paper is limited to the investigation of two IS success models. The remaining sections are organised as follows. Section 2 explains the selection of the theoretical models and briefly presents the Unified Theory of Acceptance and Use of Technology and the updated Information System Success model. Next, section 3 presents the failed public management case and the method for data collection. Section 4 examines if the IS success models can be applied to study the causes of failure of the road sign database case. Discussion on this applicability and on future research opportunities can be found in section 5. We conclude in section 6

2 Investigated models

2.1. Selection of the theoretical models

In the search to measure IS success in the private sector, nearly as many measures as studies were developed [4]. IS theorists are still grappling with the question of which constructs best represent IS success and failure [4], [8]. Despite this multitude of studies and measures, the TAM, UTAUT and the DeLone & McLean IS success model surface as leading IS success models [14].

Before 2003, the Technology Acceptance Model (TAM) was the most widely utilized theory to study IS/IT adoption within the IS discipline [5]. Different variants of the TAM were created, one being the Unified Theory of Acceptance and Use of Technology (UTAUT) [28]. Today, research on technology adoption shows that the UTAUT has the highest power in explaining behaviour intention and usage : the UTAUT explains 70% of acceptance while other models explain about 40% [29]. We therefore prefer the UTAUT above the TAM.

This paper therefore focuses on the UTAUT and the updated IS Success Model to study intergovernmental IS failure. Both models see success or failure as brought about by causally linked factors. Underlying is the assumption that IS success and failure can be identified by the presence or absence of these factors [12]. For UTAUT, the use of an IS presents an early sign of success [7]. Acceptance of an IS is seen as a possible precursor of success [19]. UTAUT has a personal user focus: it takes into account human factors such as individual expectations (on performance/efforts/ease of use), personal characteristics (age, gender, experience, voluntariness) and interaction of stakeholders (social influence). The updated IS success model, views success from a rationalist managerial perspective. Service quality, information quality and system quality are seen as key determinants of user satisfaction and (intention to) use [14]. In the next paragraphs both models are briefly discussed.

2.2. The Unified Theory of Acceptance and Use of Technology

Research in technology acceptance models culminates with UTAUT. It integrates eight models used in IT acceptance research. Venkatesh et al [28] distinguish four direct factors of user acceptance and usage behaviour: *Performance expectancy* is the degree to which an individual believes that using the system will help him to gain in job performance. Second, *effort expectancy* is the degree of ease associated with the use of the system. Third, *social influence* is the degree to which an individual perceives that important others believe he should use the new system. Finally, *facilitating conditions* are the degree to which an individual believes that an organizational and technical infrastructure exists to support the use of the system [30]. Facilitating conditions determine use. Social influence, performance and effort expectancy determine the intention to use a system. Behavioural intention in turn determines use [20].

The moderating factors are gender, age, experience and voluntariness of use. The UTAUT suggests the following: (1) gender and age moderate the effect of performance expectancy on behavioural intention; (2) gender, age and experience moderate the effect of effort expectancy on behavioural intention; (3) gender, age, experience and voluntariness moderate the effect of social influences on behaviour intention and (4) age and experience moderate the effect of facilitating conditions on behavioural intention [1].

2.3. The Updated Information System Success Model

In 1992 DeLone and McLean [3] introduced an alternative taxonomy to understand the dimensions of IS success. The taxonomy provided a scheme for classifying the multitude of IS success measures in the literature . Ten years after the publication of

their first model and based on the evaluation of the contributions to it, DeLone and McLean (D&M) proposed an updated IS success model. Now, the majority of IS researchers has switched to the updated D&M success model published in 2003 [4]. A recent meta-study has shown that most of the updated D&M model's propositions explaining the success of an IS are actually supported [19].

A first dimension of the updated D&M model is *system quality* which measures the quality of information processing within the system in terms of ease of use and learning, system flexibility and reliability... etc. *Information quality*, secondly, focuses on IS output and looks to desirable characteristics of system outputs such as relevance of information, meaningfulness, accuracy, completeness... A third dimension is *service quality*, the quality of system support that users get from the IT department such as responsiveness, accuracy or technical competence from staff... *Intention to use and use* fourthly measure the user attitude. Use is seen as a behaviour, the manner in which staff and customers use the capabilities of an IS e.g. amount and frequency of use, extent and purpose of use. *User Satisfaction*, a fifth dimension, describes the users level of satisfaction. *Net benefits* finally are the extent in which IS contributes to the success of the individuals that use the system e.g. improved decision making, productivity & efficiency [4], [9], [19], [3].

3 Methodology

3.1 Research Methodology

Zikmund (1984) suggests that the degree of uncertainty about the research problem determines the research methodologies. As mentioned little research has examined whether IS success models can be used to study intergovernmental IS failure [25]. An exploratory case study investigates, mainly in a qualitative manner, distinct phenomena characterized by a lack of detailed preliminary research [22]. This form of case study often is applied to explore a relatively new field of scientific investigation [17].

The research under study is framed in behavioural science. This paradigm seeks to verify theories that explain / predict human or organizational behaviour surrounding the analysis, design, implementation, management and use of IS. "*Such theories ultimately inform researchers and practitioners of the interactions among people, technology and organizations that must be managed if an information system is to achieve its stated purpose*" [11]. By verifying if two theoretical models are applicable to study causes of intergovernmental IS failure we aim to inform if this is possible and on what might be causes of failure during the implementation of an IS.

Since we are investigating causes of failure, a *failed* case study will be taken as starting point. The analysis of the case study is performed in the following way. Both the UTAUT and the IS success model define a number of factors that determine IS success. We first collected data about the case by means of open ended interviews by telephone. The advantage of standardized open ended interviews is that these provide a richness of details, may give the researcher perspectives he did not consider before and reduce the risk that the respondent is lead in a certain direction. Telephone interviews may reduce interviewer bias because there is no face-to-face contact [1]. All

interviews were transcribed. Subsequently, the texts of the interviews were matched against the factors of each model, in search for evidence of a positive or negative influence on ultimate IS success.

3.2 Selected Case Study

The road sign database was selected from an inventory of 100 intergovernmental IS in Flanders [27]. The case was selected because: (1) it exists since 2008 and added value of an IS only reveals itself after a number of years. (2) It was an innovating project with a cost of 20 million euro (which is a high amount for the Flemish government) and large innovating projects are likely to fail [10]. (3) Municipalities are asked to deliver data to the Flemish government voluntarily, getting municipalities there is in practice a hot topic and knotty problem. Scientifically little is known about the voluntary use of systems [7]. An explorative case study of the road sign database was conducted at the beginning of this research. In order to prevent being influenced by a theoretical lens, we explored the case by interviewing 130 municipalities with open questions. Legislation and policy documents were collected too.

The road sign database contains all road signs, their main characteristics and positions on Flemish roads. The opportunity to launch this was a huge traffic obstruction in Bruges. A bridge was hit by a truck as there was no road sign about the bridge's height. The Flemish government created the database and inventoried the road signs. It then asked its 308 municipalities and the Department of Mobility and Public Works for the Flemish roads to keep the database up-to-date but they do not.

3.3 Data Collection

In order to explore the reasons for not using the road sign database, we interviewed 23 pioneering users. 18 of them did not use the database. As we wondered if this low adoption rate counted for other municipalities, additionally 107 municipalities were questioned by telephone. In total 130 of the 308 Flemish municipalities were questioned in a systematic way. At Flemish level, we interviewed the project managers of the Flemish Agency for Roads and Traffic, the Flemish Department of Mobility and Public Works and the Agency for Geographical Information face-to-face.

During the telephone interviews municipalities were asked how frequent the database was used. If they did not (often) use it, we asked why and if they employed any alternatives. Non-users were asked if they desired to get (back) on board. Municipalities who used the system were questioned for what purpose and if they kept the database up-to-date. Table 1 summarizes the usage results.

Table 1 Road Sign Database: Frequency of use (N= 130)

Never used	Non use	Use once or few times/year	Monthly use
26	66	31	7

Four groups can be distinguished. A first consists of municipalities that never tried to use the database. Seven never started because they possess their own database. The other nineteen did not have the time or personnel to start with the database or catego-

size it as ‘not useful’. The second group enrolled but currently does not use the database. This is the case for 66 of the 130 interviewed municipalities. The third group consists of 31 municipalities that use the database once or a few times a year and the fourth group of 7 municipalities utilizes it at least once a month.

We interviewed more than one third of the Flemish municipalities. Possibly, the results could be slightly different for the whole population. We believe that the chosen municipalities are representative in size and geographical distribution. The Department of Mobility and Public Works confirmed that our results correspond to the situation of other municipalities: they do not keep their road sign information up-to-date and neither does the Agency for Roads and Traffic. As a result of the low usage, the database got spoiled.

4 Results of the Case Study Analysis

4.1 The UTAUT and the road sign database.

UTAUT allows to study the causes of failure from a personal lens. Table 2 provides an overview of the results of the interviews for each factor of this model. Each factor is concluded with the identification of main causes of failure identified according to this perspective.

Table 2. Analysis of the road sign database through the lens of UTAUT

Performance expectancy	Some municipalities hoped to save time by using the database, they soon got disillusioned. The database could not enhance their job performance. Cheap and quick alternatives made it less attractive. Promised applications on legislation were never built. → Performance expectancy scores badly because of a low time performance (C1), cheap and quick alternatives (C2) and a lack of purpose (C3)
Effort expectancy	Respondents who followed a traineeship remarked it was cancelled several times as the teacher could not enter the system. Municipalities often experienced log-in problems and the system crashed from time-to-time. The more users entered the system, the slower it functioned. → The poor effort expectancy can be linked with two causes of failure: low time performance (C1) and technological issues (C4).
Social influence	At a certain point the reputation of the database was so poor that municipalities who did not use database yet, heard the stories and decided not to use it. Other municipalities experienced problems and stopped. → A bad reputation (C5) troubled the database, the many flaws became a justification for abandonment.
Facilitating conditions	Municipal hard- or software investments were not needed as the database was a web-based application. The weak technical infrastructure did not facilitate civil servants during their task, the system was time intensive and data got lost because of crashes. → Analysis along this factor reveals poor end-user support (C6) and tech-

	nological issues (C4).
Moderating determinants: Gender, age, experience, voluntariness	<p>The use of the database is voluntary: the Flemish government just asked to keep it up-to-date. In our explorative research, gender, age and experience were rarely spontaneously mentioned by interviewees. Gender appeared to influence usage in one municipality: during a pregnancy leave the database was not used. Age seemed to play a role for three interviewees: they would soon retire and leave the start-up of the database to their replacing colleague. Experience was mentioned briefly by several respondents: <i>'for municipalities who use the database fulltime, inputting should go more easily'</i>.</p> <p>→ Because the exploratory interviews only delivered a few remarks about moderating determinants, we can't make any further statements</p>

The analysis of the different factors suggest a negative influence on behaviour intention and use behaviour. The interviews indeed confirm that because of social influence, a low performance and effort expectancy 26 municipalities never started with the database. For others, behavioural intention dropped shortly after the launch of the database. Ultimately, a dropping behaviour intention combined with poor facilitating conditions made 66 municipalities stop using the database. The Flemish Agency for Roads and Traffic stopped updating the regional roads and created its own 'road database'. Only 7 of the 130 questioned municipalities use the database minimally once a month.

To which extent does a personal oriented lens give insight in the causes of failure? By analysing the interviews through the lens of the determinants of the UTAUT, we were able to detect six causes of failure of the road sign database. As we did not explicitly ask respondents about moderating determinants, we are not able to investigate the role of these factors.

4.2 The Information System Success Model and the road sign database

The updated IS success model allows to study the causes of failure of the road sign database from a rational managerial lens. Table 3 provides an overview of the results of the interviews for the factors of this model. Each factor is concluded with the identification of main causes of failure identified according to this perspective.

Table 3. Analysis of the road sign database through the lens of the updated IS success model

Information Quality	<p>92 of the questioned municipalities do not use the database (any more). For 90 of these 92 the data is outdated and incomplete. Remarkably two municipalities who do not use it for their own decision making, keep it up-to-date once a year. On the other hand, one could expect that the 38 municipalities who use the database keep it up-to-date. Only 12 of 38 users do. There are no alternatives, if a municipality does not keep track of its road signs, no other party will. The overall information quality is low.</p> <p>→ Rather than acting (only) as a factor for IS success, Information Quali-</p>
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	ty turns out to be mainly a result of the lack of usage.
System Quality	<p>Reliability of the system appears to be low as it crashes often. The system flexibility is limited, and the more users enter the system, the slower it functions. Respondents who do not use the system on a monthly basis claim they have to figure out how it works over and over again. The overall system quality is low.</p> <p>→We see causes of failure, technical issues (C4) and low time performance (C1), resulting in low system quality.</p>
Service Quality	<p>The Flemish government has a competent staff that supports the database. But municipalities find this staff difficult to reach when experiencing problems. A few municipalities who never started with the database remarked they asked to join a training course or receive a log in code but never received an answer.</p> <p>→Service quality appears to be low and can be attributed to a lack of technical end-user support (C6)</p>
Intention to Use	<p>Intention to use is determined by the three previous factors and by net benefits (see further). Yet some respondents remarked that they intended to use the database until they heard how bad functioning it was. The Flemish government does not have legal or financial resources to encourage the updating of the database. Easy alternatives for gathering road sign information decreased the benefits of maintaining the road sign database.</p> <p>→ A lack of purpose (C3), cheap and quick alternatives (C2) and a bad reputation (C5) caused a decrease in intention to use.</p>
Use	<p>Less than 1/3 of the questioned municipalities uses the system. For those who do, the frequency of use is partly dependent on the number of new road signs.</p>
User Satisfaction	<p>User satisfaction is determined by the three previous factors and by net benefits (see further). Respondents who still use the database find it supportive for their mobility plans, to localise road signs or to advice the municipal council, this indicates the presence of some benefit for users. Yet the interviews also indicate that low system quality (slow time performance) caused many users to abandon the ship.</p> <p>→Most municipalities who once used the system, believe user satisfaction to be low because of a slow time performance (C1).</p>

Analysis of the factors suggests a negative influence on net benefits. The interviews confirm that the majority of questioned municipalities does not experience the IS as a tool to make their work more efficient. Time investments appear to outweigh net benefits. A lack of net benefits appears to be mainly caused by a lack of purpose (C3), a bad reputation (C5) and the option for cheap and quick alternatives (C2).

By filling in the factors of the D&M IS success model, six main causes of failure could be detected. The D&M IS success model not only gives insight in six causes, it also seems to point out the consequences of this failure: a poor information quality and low actual use. Unlike UTAUT it pays attention to information quality. The road sign database seems to be subjected to an implosion effect: municipalities left the

database, because of that information quality drops, this makes the database even less used which in turn further deteriorates information quality.

5 Discussion

This paper explored IS success models to study a failed intergovernmental IS. Two IS theoretical lenses were studied via an exploratory case study analysis. In total the two models exposed six main causes of failure for the road sign database:

1. Slow time performance (C1) is a reason for not using the database. Inputting or deducting data soon appeared to be time-consuming. A mobility civil servant remarked that entering ten road signs took a day. About 1/3 of the questioned municipalities claim they do not desire to invest in a slow functioning system.
2. Secondly, many cheap and quick alternatives (C2) make the slow bad functioning database less attractive. The most popular alternatives to detect a road sign are google street view, looking on the streets, searching its own register or asking the local police. Municipalities often employ several alternatives.
3. A third failing cause is a lack of purpose (C3). For the Flemish government it is interesting to have an overview of all road signs. Municipalities seem only interested in road signs on their territory. Most do not use the database for maintenance purposes. Little municipalities do not feel the need to map their signs electronically. As a respondent stated: *"We are four square kilometres large, I know every road sign by heart"*. Others claim to have an own more adapted, longer existing register. The Flemish government asked to re-enter their data as it was not possible to transfer. The local governments did not find this question very appealing.
4. A fourth cause of failure (C4) is related to technological issues. The database was plagued by severe log in troubles and frequent system crashes.
5. Fifthly, a bad reputation (C5) negatively influenced the intention to use of municipalities who considered the database.
6. A final cause of failure is lack of end user support (C6). Local governments with technological problems, could not reach the Flemish government.

In most impaired projects failure is due to several different factors which are often interrelated [5]. Here too, we see that failure is not only caused by technical failure [10], also non-technical factors and their interplay need to be taken into account [5], [22]. Using multi-measures is valuable to catch the multifaceted nature of failure [20]. Via the personal theoretical lens of UTAUT, six causes of failure could be detected. The same counts for the rational managerial lens, the updated IS success model. Remarkably these different lenses detect the same causes of failure: *Time performance* (C1) was detected in 'performance and effort expectancy' (UTAUT) and in 'system quality and user satisfaction' (IS success model). *Cheap and easy alternatives* (C2) as a cause of failure was uncovered by both models via 'performance expectancy' (UTAUT) and 'intention to use' (IS success model). The overall cause, *lack of purpose* (C3) was detected via 'performance expectancy' (UTAUT) and 'intention to use' (IS success model). *Elements of technical issues* (C4) could be found in the determi-

nants 'effort expectancy' and 'facilitating conditions' for UTAUT and in 'system quality' for the IS success model. *A bad reputation* was pictured by social influence (UTAUT) and intention to use (IS success model). *The lack of end user support* (C6) became clear via 'facilitating conditions'(UTAUT) and 'service quality' (IS success model).

This case study suggests that the user perspective represented in the UTAUT model and the rational managerial lens of the updated D&M IS success model are not competing approaches concerning intergovernmental IS failure. Al Khatib [1] also finds that the updated D&M IS success model serves as antecedent to the UTAUT model. An integration can help build a conceptual bridge [1], [1]. Combining both approaches might provide a richer understanding of failed intergovernmental IS.

The results of the case study indicate that although the applied theoretical models are called IS 'success' models, they can be used to study intergovernmental IS 'failure'. Previously we mentioned that both models see success or failure as brought about by causally linked determinants. Underlying is the assumption that IS success and failure can be identified by the presence or absence of certain determinants [12]. The six causes of failure point out that the road sign database scores low on the factors of the studied IS success models:

- For UTAUT, the combination of a bad reputation, a poor performance expectancy and effort expectancy made the behavioural intention to use the road sign database drop. Facilitating conditions and behavioural intention determine use. The absence of facilitating conditions because of poor end-user support and technical problems and a dropping behavioural intention made 67 users abandon the ship. We can speak of failed case as the road sign database was not able to meet the expectations of many stakeholders [5] and as the many flaws became a justification for abandonment.
- By following the causal logic of the updated IS success model we also come to a diagnosis of failure. The road sign database scores low on service quality and system quality. These negatively influence user satisfaction and (intention to) use. Combine this with a bad reputation and slow time performance and users drop out, they chose alternatives to collect and store their road sign data. Which in turn creates a lack of purpose of the road sign database. The absence of net benefits will affect user satisfaction and intention to use [2].

6 Conclusion and future research

Electronic intergovernmental information sharing is the new goal in the public sector. The implementation thereof is an IT and organisational challenge for the next decade. There is a need to examine whether traditional IS success models can be applied to intergovernmental IS and to study their causes of failure. In this paper we contributed to this research gap.

The applicability of two IS success models, the UTAUT of Venkatesh et al (2003) and the updated IS success model of Delone and Mc Lean (2003), was tested via an explorative case study of the failed road sign database project. Both lenses have their

value to detect causes of failure, hence their completeness in analysing the case is not proven. Part of the intellectual challenge of studying intergovernmental electronic collaboration is blending multiple theoretical and research perspectives to obtain a complete picture [21]. The combination of different IS success lenses in a more comprehensive model might be a valuable future contribution to e-government studies.

Exploratory research is broad in focus and rarely provides definite answers to specific research issues [17]. The findings are therefore limited and cannot be generalized. Hence, this study needs to be replicated in the future to see if testing IS success models on other failed intergovernmental information systems yields the same results.

In future research we will also consider the use of more theory fitting, less open questions. As such, variables like the moderating determinants of the UTAUT can be questioned more explicitly. Another limitation of the study is that other lenses on failure exists such as an IS constructivist narrative and socio material approach of failure. We could test them in an e-government context [12].

7 References

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